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Efficacy of admission cardiotocography on neonatal outcome in term pregnancy admitted in labor in a rural-based tertiary care center: A prospective study

Suchismita Bera[1], Debjani Deb[2], Rahul Ballov[3], Sohanjan Chakraborty[4]

[1]Senior Resident, [2]Associate Professor, Department of Obstetrics and Gynaecology, [3]Junior Resident, Department of Microbiology, [4]Senior Resident, Department of Community Medicine, Bankura Sammilani Medical College and Hospital, Bankura, West Bengal, India

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ABSTRACT

Background: Cardiotocography (CTG) is first-line investigation for antepartum and intrapartum fetal assessment. Fetal monitoring during labor helps identifying fetuses at risk of hypoxic damage and helps institute appropriate intervention to optimize perinatal outcome and prevent neurological injuries. **Aims and Objectives:** The present study was conducted to evaluate the efficacy of CTG on neonatal outcome and levels of obstetric intervention in term pregnancy admitted in labor. **Materials and Methods:** The prospective study was conducted in Bankura Sammilani Medical College and Hospital during June 2019–December 2020 among 180 pregnant women in term having no obstetric complications that warranted continuous monitoring of fetal heart rate admitted in labor. Principles of descriptive statistics were used. **Results:** The mothers were classified into three groups such as labor admission test (LAT) reactive, LAT suspicious, and LAT pathological. Majority of the mothers were aged <20 years, nullipara, primigravida, having clear liquor, which underwent emergency LUCS. About 35% mothers were carrying fetus having distress. The newborns of almost 44% mothers were admitted in NICU. The sensitivity of admission CTG to detect intrapartum fetal distress is 84.13%, specificity is 67.52%, positive predictive value is 58.24%, and negative predictive value is 88.76%. **Conclusion:** Admission CTG does not benefit the neonatal outcome in normal- or low-risk women and rather results in increased obstetric intervention.

Key words: Cardiotocography; Efficacy; Labor; Neonatal outcome; Term pregnancy

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INTRODUCTION

The cry of her newborn baby is the most yearned by and the sweetest sound for a mother. It is the fruit of watchful labor for an obstetrician which comprises of maternal and fetal surveillance. To ensure the delivery of a healthy baby in good condition with minimum intervention, fetal surveillance during labor is extremely important.[1] Fetal monitoring during labor helps identifying fetuses at risk of hypoxic damage and helps institute appropriate intervention to optimize perinatal outcome and prevent neurological injuries.[2] Electronic Fetal Monitoring (EFM) has thus been widely been adopted.[3] Features of FHR such as baseline variability, accelerations, and decelerations are difficult to quantify with intermittent auscultation.[4] Therefore, the use of cardiotocography (CTG) has increased rapidly and today CTG is first-line investigation for antepartum and intrapartum fetal assessment.[5] Economic constraints especially in many developing countries are a limiting factor for the use of cardiotocographic or EFM for all antenatal patients admitted to the labor room.[6] Therefore, selection of patients for continuous EFM is recommended for high-risk patients in busy labor room with few monitors.[7] Ingemarsson et al.,[8] therefore, suggested an alternative method of monitoring FHR during labor to pick the women apparently at risk, whose fetuses were compromised

Address for Correspondence:
Dr. Sohanjan Chakraborty, Senior Resident, Department of Community Medicine, Bankura Sammilani Medical College and Hospital, Bankura, West Bengal, India. **Mobile:** 6297529322. **E-mail:** csohanjan1990@gmail.com

by Labor Admission Test (LAT).[4] LAT by CTG helps differentiate between mothers, in whom continuous fetal monitoring is needed and those who can be managed by intermittent auscultation. The admission CTG is a short 20 min recording of FHR immediately after admission to the labor ward.[9] The uterine contractions of labor put stress on placental circulation; an abnormal tracing in CTG indicates uteroplacental deficiency identifies fetal compromise at the early stage to allow intervention.[10] In non-industrialized countries with inadequate antenatal care, heavy workload and inadequate resources an admission test has a role in obstetric units in "triaging" fetuses by providing a "snap-shot" view of fetal well-being at the time of admission in labor.[2] Thus, a prospective study has been conducted to evaluate the efficacy of CTG on neonatal outcome and levels of obstetric intervention in term pregnancy admitted in labor in a peripheral-based tertiary medical college with approximately 23,000 (twenty three thousand) deliveries per year.

Aims and objectives

The aims of this study were as follows:

- To determine the sensitivity and specificity of CTG as admission test for intrapartum fetal distress.
- To determine the predictive value of normal and abnormal CTG pattern to correlate perinatal outcome so as to identify fetal compromise at an early stage and take intervention.

MATERIALS AND METHODS

Study design, settings, and population

It was a hospital-based prospective cohort study with a longitudinal design conducted in the maternity center of Bankura Sammilani Medical College and Hospital for 1½ year from the month of June 2019 to December 2020. Pregnant women in term pregnancy (>37 week gestational age) who have no obstetric complications that warranted continuous monitoring of fetal heart rate admitted in labor were considered to be the study subjects.

Inclusion and Exclusion criteria

Women who were booked for hospital delivery, having a gestation of ≥37 weeks, were in the first stage of labor (spontaneous onset) with the fetus in cephalic presentation during the antenatal period or at that visit were included as study subjects, whereas women having obstetric complications at that visit which will warrant continuous intrapartum monitoring of fetal heart rate such as pre-eclampsia or hypertension in the previous or index pregnancy; essential hypertension; diabetes (insulin dependent or gestational); suspected intrauterine growth restriction; placental abruption or previa or vaginal bleeding of unknown origin; multiple pregnancies; fetal malformation; previous cesarean section; breech presentation; and Rhesus isoimmunisation were excluded from the study.

Sample size and sampling technique

Sample size

Sample size for the study was 170 calculated based on the formulae (designed by the WHO) $n=(z/e)^2$, where z=1.96 at 95% Confidence Interval, e=Allowable error around the expected prevalence which is assumed to be 15% of the proposed study. Considering 10% non-response rate, the final sample size became 180.

Sampling technique

Sampling design for the proposed study was done as follows:

Data for the proposed study were collected for a period of approximately 45 weeks and according to the feasibility, the data were collected for 2 days in a week, that is, 90 days. Average number of deliveries in the proposed setup was 60/day.

Total number of sample included in the proposed study=180.

Therefore, number of mothers included in each day=180/90=2 mothers/day/week.

The days were selected following a simple random sampling by lottery method at the starting of each week and the study subjects were selected/day also through simple random sampling using random number table.

A queue of 60 patient numbered sequentially from 1 to 60 was imagined (sampling frame for each day) 2 out of this 60 were selected via simple random sampling using random number table.

When total number of deliveries became >60, then the number was selected via dividing the selected number by average total number of delivery per day and then selecting the remainder as sample.

Study tools and techniques

Study tools

- CTG machine
- Pre designed, pretested, and semi-structured schedule
- Available records
- Bed head ticket
- The EFM was carried out using Oxford Sonic aid 8002 CTG machine where one probe is meant to pick up continuous tracing of FHR and other for uterine contractions. The paper speed is set at 1 cm/min.

Study techniques

- Monitoring the patient for 20 min in 1st stage of labor through admission CTG.
- Interpreting the result under three sub headings: reactive, pathological, and suspicious based on 5 components: Baseline heart rate, Beat to Beat variability, Accelerations, Decelerations, and Sinusoidal pattern.
- Interventions taken according to the obstetric complications.
- Neonatal outcome measured on proposed parameters.

Method

History and clinical examination

On admission to the labor ward, detailed medical, surgical, and obstetric history were obtained. History of reduced fetal movements is important. General examination should include – estimation of body mass index, blood pressure, temperature, and signs of anemia. Thorough abdominal examination needs to be carried out including symphysial-fundal height measurement, assessment of fetal lie, presentation, station of presenting part, and nature of contractions.

Procedure

Simultaneous recordings were performed by two separate transducers, one for the measurement of the fetal heart rate, and a second one for the uterine contractions. Transducers may be either external or internal. External measurement means strapping the two transducers to the abdominal wall

- The pressure-sensitive contraction transducer, called a tocodynamometer (toco), measures the tension of the maternal abdominal wall – an indirect measure of the intrauterine pressure
- The fetal heart rate transducer overlays the fetal heart, measures the fetal heart rate.

[Note: Internal monitoring differs from external monitoring.

- The pressure-sensitive contraction transducer, called a tocodynamometer (toco hereafter), measures the tension of the maternal abdominal wall – an indirect measure of the intrauterine pressure
- The fetal heart rate transducer is replaced by a smaller lead that is placed inside the woman's vagina and attached to the head of the baby. The internal lead is called a "fetal scalp electrode." It is only used to monitor the baby's heart rate during labor, usually if external monitoring is not being reliable.]

Study variables

Independent variables

Sociodemographic variables were as follows: Age, religion, and residence.

Dependent variables

For the present analysis, the outcome variables were as follows:

- MSL (Nil, Thin, or Thick)
- Mode of delivery (Vaginal, Instrumental [vacuum or forceps] or LSCS)
- Fetal distress
- NICU Admission

Ethical clearance

The ethical clearance was obtained from the Institutional Ethics Committee of Bankura Sammilani Medical College. Ethical clearance number was BSMC/Aca/116, dated 09.01.2019.

Data collection

Data collection was started after obtaining permission from concerned authority of Bankura Sammilani Medical College and Hospital. We had selected 180 women at the gestational age more than 37 weeks in 1st stage of labor. After preliminary investigation, written informed consent was taken. The procedure and its probable complication were explained to the patient. After that, the cases were randomly selected for admission CTG. After procedure, various parameter were compared based on proposed parameters.

Data analysis

After collection data were entered into the Microsoft Excel sheet and it was checked twice to detect any erroneous entry. After organizing and presenting the data in the forms of tables and diagrams, they were analyzed applying the principles of descriptive statistics. SPSS version 20 was used to analyze the data.

RESULTS

Table 1 revealed that majority of the mothers were aged <20 years, nullipara, primigravida, having clear liquor, which underwent emergency LUCS. About 35% mothers were carrying fetus having distress. The newborns of almost 44% mothers were admitted in NICU.

Sensitivity = ({53/[3+10]} × 100) % = 84.13%
Specificity = ({79/[79+38]} × 100) % =67.52%
Positive Predictive Value = ({53/[53+38]} × 100) % =58.24%
Negative Predictive Value = ({79/[79+10]} × 100) % = 88.76%

Table 2 revealed that the positive predictive value of admission CTG to detect intrapartum fetal distress is 58.24% and negative predictive value is 88.76%.

Table 1: Interpretation of Labor Admission Test according to background characteristics (n=180)

Background Characteristics	LAT Interpretation			Total (%)
	Reactive	Suspicious	Pathological	
Age				
<20	60	45	16	121 (67.2)
20–25	21	7	16	44 (24.5)
>25	8	0	7	15 (8.3)
Parity				
Nullipara	37	45	16	98 (54.4)
Multipara	52	7	23	82 (45.6)
Gravida				
Primigravida	37	45	16	98 (54.4)
Multigravida	52	7	23	82 (45.6)
Mode of delivery				
Normal vaginal	14	23	32	69 (38.3)
Emergency LUCS	75	29	7	111 (61.7)
Liquor				
Clear	89	22	0	111 (61.7)
Thick meconium stained	0	0	23	23 (12.7)
Thin meconium stained	0	30	16	46 (25.6)
Fetal distress				
Present	10	30	23	63 (35)
Absent	79	22	16	117 (65)
NICU admission				
Done	10	30	39	79 (43.9)
Not done	79	22	0	101 (56.1)
Total	89	52	39	180 (100)

Sensitivity = ({69/[69+10]} × 100) % = 87.34%
Specificity = ({79/[79+22]} × 100) % = 78.22%
Positive Predictive Value = ({69/[69+22]} × 100) % = 75.82%
Negative Predictive Value = ({79/[79+10]} × 100) % = 88.76%

Table 3 showed that sensitivity of admission CTG to detect intrapartum fetal distress is 84.13%, while the specificity is 67.52%.

Table 2: Cardiotocography as a screening test of fetal distress (n=180)

Cardiotocography	Fetal distress		
	Positive	Negative	Total
Positive	53	38	91
Negative	10	79	89
Total	79	101	180

Table 3: Cardiotocography as a screening test of NICU admission (n=180)

Cardiotocography	NICU admission		
	Positive	Negative	Total
Positive	69	22	91
Negative	10	79	89
Total	79	101	180

DISCUSSION

Assessment of the fetal condition depended on very limited means until last century. CTG is worldwide the method for fetal surveillance during labor. Although it is applied on a large scale, this technique is still subject to debate. CTG provides direct information of fetal condition in contrast to other mainstay of intrapartum fetal assessment. In present prospective study, the various fetal heart rate patterns (reassuring, non-reassuring, and abnormal) in low risk antenatal women are found. According to NICE guidelines 2001, CTG traces were divided into reassuring, non-reassuring and abnormal. Mahomed et al.,[11] reported that the late deceleration was the commonest type of pattern in 21% cases. Haverkamp et al.,[12] documented acceleration and early deceleration as the most common type of pattern and late deceleration only in 7% cases. In our study, most common pattern observed was reactive (50%) followed by suspicious (29.1%) then pathological (20.8%) which is comparable to the above studies done by Chaudhari et al., Mahomed et al., and Impey et al., but the pathological and suspicious group was much larger than Havercamp et al., and Mires et al. Our study observed that the most common pattern with meconium-stained liquor was late deceleration. Meconium-stained liquor was more common in the cases which had abnormal pattern. Total Meconium-stained liquor cases was seen in 29.1% cases which are comparable to the studies done by Chua et al.,[13] with MSL found in 16% cases. The fetal heart rate pattern is greatly affected by meconium-stained liquor and is poor prognostic factor for perinatal outcome. Regarding

mode of delivery in our study about 80% patients with suspicious and pathological CTG pattern underwent cesarean section and 20% delivered vaginally. In our study, 23 (42.8%) patients having suspicious CTG had EMLUCS and 30 (57.1%) patients had normal delivery, while patients who were having pathological traces 32 (80%) patients had EMLUCS and 7 (20%) patients had normal delivery. Rajalekshmi et al.,[14] documented that out of 400, 267 (66.75%) women had reactive tracings, 114 (28.5%) had suspicious, and 19 (4.75%) had ominous tracings. In reassuring group, 179 (44.75%) had vaginal deliveries. In suspicious trace, 2 (0.5%) had vaginal deliveries, 7 (1.75%) had instrumental delivery, and 105 (26.25%) underwent LSCS. All women with ominous trace underwent LSCS. The sensitivity of admission CTG to detect intrapartum fetal distress is 84.13%, specificity is 67.52%, positive predictive value is 58.24%, and negative predictive value is 88.76%. The study is comparative to Sultana et al.,[15] with sensitivity 87%, specificity is 66%, positive predictive value is 54%, and negative predictive value is 92%. Further studies with a larger number of patients and modalities of fetal monitoring are suggested. Except for a few single study outcomes, the predictive value of the labor admission test was poor. In the randomized controlled trials, the labor admission test led to more and more surgical interventions without any significant improvement in neonatal outcome. Among the pathological group, 68.42% of newborn had NICU admission. Our study showed out of 26 NICU admissions, 1.1% were in reassuring group, 12.3% in suspicious trace, and 47.4% in ominous trace. The present study showed that there were more obstetrical interventions in the labor test group than in control group. Most likely cause for this could be high proportions of abnormal tests. An abnormal test is usually followed by continuous electronic fetal monitoring, which can again lead to unnecessary and excessive surgical interventions.

Limitations of the study

A randomized control trial with a larger number of mothers would have been more appropriate to evaluate the efficacy of admission cardiotocography as a screening test which could not be performed due to logistic constrains.It would have been more useful finding of this study if the efficacy of admission cardiotocography was compared to that of the other modalities of screening neonatal outcome.

CONCLUSION

This study emphasis on the role of labor admission test in planning early intervention as majority of the patients with a pathological tracing landed up in caesarean delivery. It also prevents neonatal morbidity and mortality as the high NPV (98.7%) of the study reflects on the importance of AT in identifying a compromised fetus. The load of continuous monitoring in high-risk patients can be decreased thus proving to be a time saving method in intervention required, especially in institutes with a high patient load. The admission CTG could identify nearly twice as many fetuses with an abnormal pattern that increases the need for cesarean section. Hence, chances of cesarean section are slightly more in high-risk cases. Hence, admission CTG does not benefit the neonatal outcome in normal- or low-risk women and rather results in increased obstetric intervention. Thus, as screening test further studies with a large number of patients based on randomized control trial may be taken for assessing efficacy of labor admission test.

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Authors Contribution:
SB, DD- Concept and design of the study, prepared first draft of manuscript; **SB, RB-** Reviewed the literature, and manuscript preparation; **DD, SC**- Concept, coordination, statistical analysis and interpretation, Interpreted the results; **RB, SC**- Revision of the manuscript

Work attributed to:
Bankura Sammilani Medical College and Hospital, Bankura, West Bengal, India

Orcid ID:
Dr. Sohanjan Chakraborty - https://orcid.org/0000-0002-9361-2844
Suchismita Bera - https://orcid.org/0000-0002-5879-8065
Debjani Deb - https://orcid.org/0000-0002-8483-8251
Rahul Ballov - https://orcid.org/0000-0002-0128-0169

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